CLAIMS

1   1.   A dynamic gain flattening filter configured to receive an
2 optical signal, comprising:
3   a first filter stage including,
4   a first tunable coupling member;
5   a first differential delay with first and second tunable delay paths;
6 and
7   wherein the first tunable coupling member adjusts an amount of
8 power of the optical signal divided onto the first and second tunable delay
9 paths of the first differential delay.

1   2.   The filter of claim 1, wherein the first differential delay
2 includes a fixed portion and a tunable portion.

1   3.   The filter of claim 1, wherein the first differential delay
2 includes a first fixed differential delay and a first tunable differential delay
3 with respect to the first and second tunable delay paths.

1   4.   The filter of claim 3, wherein the first fixed differential delay
2 sets a periodic variation in a power spectrum of the optical signal.

1   5.   The filter of claim 3, wherein the first tunable differential
2 delay sets a phase of the periodic variation in the power spectrum of the
3 optical signal.

1   6.   The filter of claim 3, wherein the first fixed differential delay
2 is positioned between the first tunable coupling member and the first tunable
3 differential delay.

1   7.   The filter of claim 3, wherein the first tunable differential

2 delay is positioned between the first tunable coupling member and the first

3 fixed differential delay.

1   8.   The filter of claim 1, further comprising:

2   a second stage including:

3   a second tunable coupling member ;

4   a second differential delay with first and second tunable

5 delay paths; and

6   wherein the second tunable coupling member adjusts an amount of

7 power of the optical signal divided onto the first and second tunable delay

8 paths of the second differential delay.

1   9.   The filter of claim 8, wherein the second differential delay

2 includes a fixed portion and a tunable portion.

1   10.   The filter of claim 8, wherein the second differential delay

2 includes a second fixed differential delay and a second tunable differential

3 delay with the first and second tunable delay paths.

1   11.   The filter of claim 10, wherein the second fixed differential

2 delay sets a periodic variation in a power spectrum of the optical signal.

1   12.   The filter of claim 10, wherein the second tunable differential

2 delay sets a phase of the periodic variation in the power spectrum of the

3 optical signal.

1   13.   The filter of claim 10, wherein the second fixed differential

2 delay is positioned between the second tunable coupling member and the

3 second tunable differential delay.

1   14.   The filter of claim 10, wherein the second tunable differential

2   delay is positioned between the second tunable coupling member and the

3   second fixed differential delay.

1   15.   The filter of claim 3, wherein each of the differential delays

2   is a polarization dependent differential delay.

1   16.   The filter of claim 3, wherein the first fixed differential delay

2   generates a time delay between first and second polarizations of the optical

3   signal.

1   17.   The filter of claim 3, wherein the first tunable differential

2   delay changes an optical phase between first and second polarizations of the

3   optical signal.

1   18.   The filter of claim 3, wherein the first tunable coupling

2   member is a polarization state transformer that transform the incoming

3   signal beam from one polarization state to a different polarization state.

1   19.   The filter of claim 3, wherein the first tunable differential

2   delay modifies first and second polarizations of the optical signal with

3   different phase relationships.

1   20.   The filter of claim 3, wherein the first tunable coupling

2   member includes first and second liquid crystal alignment members coupled

3   to a voltage source.

1   21.   The filter of claim 20, wherein liquid crystals in the first and

2   second liquid crystal alignment members are orientated at different angles

3   with respect to each other.

1   22.   The filter of claim 20 wherein liquid crystals in the first and
2   second liquid crystal alignment members are orientated at the same angle
3   with respect to each other..

1   23.   The filter of claim 20, wherein liquid crystals in the first
2   liquid crystal alignment member are orientated orthogonal to liquid crystals
3   in the second liquid crystal alignment member.

1   24.   The filter of claim 3, wherein the first tunable differential
2   delay includes first and second liquid crystal alignment members coupled to
3   a voltage application member.

1   25.   The filter of claim 24, wherein liquid crystals in the first and
2   second liquid crystal alignment members are orientated at the same angle.

1   26.   The filter of claim 24, wherein liquid crystals in the first and
2   second liquid crystal alignment members are orientated at different angles
3   with respect to each other..

1   27.   The filter of claim 3, wherein at least one of the tunable
2   coupling members and the tunable differential delays is a liquid crystal
3   tuning element.

1   28.   The filter of claim 3, wherein at least one of the tunable
2   coupling members and the tunable differential delays is a Faraday rotation
3   member.

1   29.   The filter of claim 3, wherein at least one of the tunable
2   coupling members and the tunable differential delays is an electro-optic
3   member.

1   30.   The filter of claim 3, wherein at least one of the tunable

2   coupling members and the tunable differential delays is a thermal tuning

3   member.

1   31.   A dynamic gain flattening filter configured to receive an

2   optical signal, comprising:

3   a first filter stage including,

4   a first tunable coupling member;

5   a first differential delay with first and second tunable delay paths;

6   wherein the first tunable coupling member adjusts an amount of

7   power of the optical signal divided onto the first and second tunable delay

8   paths of the first differential delay and

9   a first polarization splitter positioned adjacent to the first filter stage,

10   the first polarization splitter splitting the optical signal into two orthogonal

11   polarizations.

1   32.   The filter of claim 31, wherein the first differential delay

2   includes a fixed portion and a tunable portion.

1   33.   The filter of claim 31, wherein the first differential delay

2   includes a first fixed differential delay and a first tunable differential delay

3   with the first and second tunable delay paths.

1   34.   The filter of claim 33, wherein the first fixed differential

2   delay sets a periodic variation in a power spectrum of the optical signal.

1   35.   The filter of claim 33, wherein the first tunable differential

2   delay sets a phase of the periodic variation in the power spectrum of the

3   optical signal.

1   36.   The filter of claim 31, wherein the first polarization splitter is

2   a polarization walk-off crystal.

1   37.   The filter of claim 31, wherein the first polarization splitter is

2   a polarization beam splitter.

1   38.   The filter of claim 33, wherein the first fixed differential

2   delay is positioned between the first tunable coupling member and the first

3   tunable differential delay.

1   39.   The filter of claim 33, wherein the first tunable differential

2   delay is positioned between the first tunable coupling member and the first

3   fixed differential delay.

1   40.   The filter of claim 31, further comprising:

2   a first half-wave plate positioned between the first polarization

3   splitter and the first stage.

1   41.   The filter of claim 31 , further comprising:

2   a second stage including:

3   a second tunable coupling member ;

4   a second differential delay with first and second tunable delay paths;

5   and

6   wherein the second tunable coupling member adjusts an amount of

7   power of the optical signal divided onto the first and second tunable delay

8   paths of the second differential delay.

1   42.   The filter of claim 41, wherein the second differential delay

2   includes a fixed portion and a tunable portion.

1   43.   The filter of claim 41, wherein the second differential delay

2   includes a second fixed differential delay and a second tunable differential

3   delay with the first and second tunable delay paths.

1   44.   The filter of claim 43, wherein the second fixed differential

2   delay sets a periodic variation in a power spectrum of the optical signal.

1   45.   The filter of claim 43, wherein the second tunable differential

2   delay sets a phase of the periodic variation in the power spectrum of the

3   optical signal.

1   46.   The filter of claim 43, wherein the second fixed differential

2   delay is positioned between the second tunable coupling member and the

3   second tunable differential delay.

1   47.   The filter of claim 43, wherein the second tunable differential

2   delay is positioned between the second tunable coupling member and the

3   second fixed differential delay.

1   48.   The filter of claim 43, further comprising:

2   a second polarization splitter positioned adjacent to the first stage,

3   the second polarization splitter combining the two orthogonal polarizations.

1   49.   The filter of claim 48, further comprising:

2   a first half-wave plate positioned between the first polarization

3   splitter and the first stage; and

4   a second half-wave plate positioned between the second walk-off

5   crystal and the second stage.

1   50.   The filter of claim 48, wherein the first and second

2 orthogonal polarizations of the optical signal travel independently through

3 the first and second tunable differential delays.

1   51.   The filter of claim 43, wherein each of the differential delays

2 is a polarization dependent differential delay.

1   52.   The filter of claim 43, wherein the first fixed differential

2 delay generates a time differential delay between first and second

3 polarizations of the optical signal.

1   53.   The filter of claim 43, wherein the first tunable differential

2 delay changes an optical phase between first and second polarizations of the

3 optical signal.

1   54.   The filter of claim 43, wherein the first tunable coupling

2 member is a polarization state transformer that transform the incoming

3 signal beam from one polarization state to a different polarization state.

1   55.   The filter of claim 43, wherein the first tunable differential

2 delay modifies first and second polarizations of the optical signal with

3 different phase relationships.

1   56.   The filter of claim 43, wherein the first tunable coupling

2 member includes first and second liquid crystal alignment members coupled

3 to a voltage source.

1   57.   The filter of claim 56, wherein liquid crystals in the first and

2 second liquid crystal alignment members are orientated at different angles

3 with respect to each other.

1   58.   The filter of claim 56, wherein liquid crystals in the first
2 liquid crystal alignment member are orientated at 0 ° and the liquid crystals
3 in the second liquid crystal alignment member are orientated at 90 °.

1   59.   The filter of claim 43, wherein the first tunable differential
2 delay includes first and second liquid crystal alignment members coupled to
3 a voltage application member.

1   60.   The filter of claim 59, wherein liquid crystals in the first and
2 second liquid crystal alignment members are orientated at the same angle.

1   61.   The filter of claim 59, wherein liquid crystals in the first and
2 second liquid crystal alignment members are orientated at an orthogonal
3 angle to each other.

1   62.   The filter of claim 43, wherein each of the tunable coupling
2 members and the tunable differential delays is a liquid crystal tuning
3 element.

1   63.   The filter of claim 43, wherein at least one of the tunable
2 coupling members and the tunable differential delays is a Faraday rotation
3 member.

1   64.   The filter of claim 43, wherein at least one of the tunable
2 coupling members and the tunable differential delays is a electro-optic
3 member.

1   65.   The filter of claim 43, wherein at least one of the tunable
2 coupling members and the tunable differential delays is a thermal tuning
3 member.